

Appl. No. 10/710,581
Amdt. dated June 3, 2005
Reply to Office action of May 4, 2005

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

- 5 1. (original) A method for patterning an HfO₂-containing gate dielectric, the method comprising:
- 10 providing a wafer having a trench, a STI layer formed in the trench, the HfO₂-containing gate dielectric covering the wafer and the STI layer, a gate electrode formed on the HfO₂-containing gate dielectric, and at least a spacer formed beside the gate electrode; preheating the wafer; and providing a bromine-rich gas plasma to remove portions of the HfO₂-containing gate dielectric.
- 15 2. (original) The method of claim 1 wherein the method comprises utilizing a lamp tray heater to preheat the wafer.
3. (original) The method of claim 1 wherein the method comprises utilizing a non-reactive gas plasma to preheat the wafer.
- 20 4. (original) The method of claim 1 wherein the bromine-rich gas plasma comprises a Br₂ plasma, a HBr plasma, or a mixture of a Br₂ plasma and a HBr plasma.
- 25 5. (original) The method of claim 1 wherein concentration of the bromine-rich gas plasma is higher than 30%.
6. (original) The method of claim 1 wherein the wafer is preheated to a

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controlled temperature of higher than 200°C .

7. (original) The method of claim 1 wherein the STI layer comprises SiO₂.

5 8. (original) The method of claim 1 wherein the spacer comprises SiO₂.

9. (original) The method of claim 1 wherein the gate electrode comprises TaN or TiN.

10 10. (original) The method of claim 1 wherein the wafer further has a sacrifice layer formed on the gate electrode.

11. (original) The method of claim 10 wherein the sacrifice layer comprises SiO₂.

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12. (original) A method for etching an HfO₂-containing dielectric, the method comprising:

providing a wafer having the HfO₂-containing dielectric;

preheating the wafer; and

20 providing a bromine-rich gas plasma to remove portions of the HfO₂-containing dielectric.

13. (original) The method of claim 12 wherein the method comprises utilizing a lamp tray heater to preheat the wafer.

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14. (original) The method of claim 12 wherein the method comprises utilizing a non-reactive gas plasma to preheat the wafer.

15. (original) The method of claim 12 wherein the bromine-rich gas plasma

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comprises a Br₂ plasma, a HBr plasma, or a mixture of a Br₂ plasma and a HBr plasma.

16. (original) The method of claim 12 wherein concentration of the
5 bromine-rich gas plasma is higher than 30%.

17. (original) The method of claim 12 wherein the wafer is preheated to a controlled temperature of higher than 200°C.

10 18. (withdrawn) A method for patterning an HfO₂-containing gate dielectric, the method comprising:

providing a wafer having a trench, a STI layer formed in the trench, the HfO₂-containing gate dielectric covering the wafer and the STI layer, a gate electrode formed on the HfO₂-containing gate
15 dielectric, and at least a spacer formed beside the gate electrode;
performing a nitrogen ion bombardment to convert the exposed HfO₂-containing gate dielectric to an Hf₃N₄ layer; and
utilizing a phosphoric acid to remove the Hf₃N₄ layer.

20 19. (withdrawn) The method of claim 18 wherein the STI layer comprises SiO₂.

20. (withdrawn) The method of claim 18 wherein the spacer comprises SiO₂.
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21. (withdrawn) The method of claim 18 wherein the gate electrode comprises TaN or TiN.

22. (withdrawn) The method of claim 18 wherein the method comprises

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utilizing a nitrogen gas or a nitrogen-contained gas to perform the nitrogen ion bombardment.

23. (withdrawn) The method of claim 18 wherein the phosphoric acid
5 comprises a H₃PO₄ solution.

24. (withdrawn) The method of claim 18 wherein the Hf₃N₄ layer is removed at temperature between 50°C and 300°C.

10 25. (withdrawn) A method for etching an HfO₂-containing dielectric, the method comprising:

providing a wafer having the HfO₂-containing dielectric;
performing a nitrogen ion bombardment to convert portions of the
HfO₂-containing dielectric to an Hf₃N₄ layer; and
15 utilizing a phosphoric acid to remove the Hf₃N₄ layer.

26. (withdrawn) The method of claim 25 wherein the method comprises utilizing a nitrogen gas or a nitrogen-contained gas to perform the nitrogen ion bombardment.

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27. (withdrawn) The method of claim 25 wherein the phosphoric acid comprises a H₃PO₄ solution.

28. (withdrawn) The method of claim 25 wherein the Hf₃N₄ layer is
25 removed at temperature between 50°C and 300°C.